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STUDY OF SEASONAL VARIATIONS IN POPULATION DYNAMICS OF SPIDER FAMILIES IN PADDY AGRO-ECOSYSTEM, SABOUR, BHAGALPUR, BIHAR, INDIA

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ABSTRACT

Ongoing study unveiled the seasonal variations in population dynamics of various spider families and weather parameter that correlate with crop age in the paddy agro - ecosystem. A study was carried out at the Bihar Agricultural College Farm, Sabour, Bhagalpur, during Kharif season in 2014. Collections of spiders were initiated at 15 Days After Transplanting (DAT), and were continued up to 105 DAT at fifteen days interval from the field size was 30X30 m^2. 10 double sweeps were done at a stretch and the collected spiders were kept in the separate plastic bottle containing 70 % alcohol. This process was repeated five times at five different places of the field. Population of different families was noted down and was correlated with the weather parameters like Temperature (˚C, maximum and minimum), Relative Humidity (% at 7 AM and 2 PM) and Rainfall (mm). We had found all the six spider families, the population growth showed a gradual increase in the 15^{th}, 30^{th} and 45^{th} DAT followed by a slight decrease in the 60^{th} DAT after which it continued to grow up to the 90^{th} DAT when it reached the peak and then showed a sudden decline at 105 DAT. The maximum relative humidity (%) had a significant and positive impact on the population of the spider families namely Oxyopidae, Salicidae and Thomisidae. The other meteorological parameters were not found to have a significant effect on the spider families.

KEYWORDS: ***spider families namely Oxyopidae, Salicidae and Thomisidae, spiders occupy the important position in suppressing pest populations***

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Original Article

INTRODUCTION

Rice belongs to the genus *Oryza* under tribe *Oryzeae*, in grass family Gramineae (or Poaceae). *Oryza sativa* is distributed all over the world, with a high concentration in Asia. In Bihar, the total area under rice cultivation is 3.3 million hectares, which contributes to a total production of 8.1 million tones, with an average productivity of 2.4 tone/ha (Anonymous, 2013). As the area under cultivation is gradually being decreased and demand for enhanced production is increasing, emphasis is being given towards intensification through higher inputs and cropping intensity. Such efforts in turn increase pest intensities (Heong *et al.*, 1995) and losses caused by pests, remains as an important constraint for achieving higher paddy yields. Thus, in recent years, the importance of reducing losses from pests gains greater focus. Out of nearly 800 insect pest species recorded on paddy, only 18–20 species are major pests in tropical Asia. Some arthropod natural enemies have existed in this environment for thousands of years and have contributed to keep the pest species below damaging levels. Conservation of natural enemies in the paddy fields, particularly spiders may suppress the pest population, which in turn can reduce the rate of insecticide application. In India, some attempts have been made to study the

incidence of paddy pests and their associated natural enemies in Andhra Pradesh (Rao and Ali, 1976), Punjab (Brar *et al.*, 1994), Karnataka (Naganagoud *et al.*, 1999), and Bihar (Sahu *et al*., 1998, Rai *et al.*, 2000, Goswami *et al.*, 2015). Amongst various natural enemies associated with paddy-pests, spiders occupy the important position in suppressing pest populations (Barrion and Litsinger, 1984). There are positive correlation between crop age and insect pest populations, whereas with most of the abiotic parameters there was a negative correlation (Singh *et al.*, 2000). The population fluctuation of spiders in paddy fields was studied by Narayanaswamy (1999).

Therefore, the present study, we analyze the increasing population growth of spider families correlated to the crop age and correlated with some weather parameters.

MATERIAL AND METHODS

Spiders belonging to different families were collected by collection sweep net (30cm in diameter) from the field where no chemical pest management strategies were taken up. Total field size was 30X30 m^2. Collection of spiders was started at 15 days after transplanting (DAT) and it was continued up to 105 DAT at the fifteen days interval. 10 double sweeps were done at a stretch and the collected spiders were kept in separate plastic bottle containing 70 % alcohol. This process was repeated five times at five different places of the field. The spiders collected each time (after 10 double strokes) were collected separately. Those were brought to the laboratory for identification at family level and thus data on population of spiders at family level for each date of observation (different days after transplanting) were recorded. From five plastic bottles spiders belonging to different families were separated and total count (for each family) was taken up. Population of different families was noted down and was correlated with the weather parameters like Temperature (˚C, maximum and minimum), Relative Humidity (% at 7 AM and 2 PM) and Rainfall (mm).

RESULTS

Weather Trend During the Crop Season

Daily meteorological data [Maximum temperature (˚C), minimum temperature (˚C), % Relative humidity (at 7.00 AM and at 2.00 PM) and rainfall (mm)] during the whole crop growth period was collected from the automatic weather station of the university situated at BAC, Sabour farm. The daily weather data was converted to an average of fifteen days (daily data of fifteen days prior to the date of observation was taken from average) which is given in Figure 1.a. The average data was taken in studying the correlation. It can be depicted from the figure (Figure 1.a) that the maximum temperature (average of fifteen days prior to the date of observation) was recorded highest as 33.07 ˚C at 15 DAT and low as 30.57 on 105 DAT. The minimum temperature during the period of observation ranged from 24.99 ˚C (30 DAT) to 17.19 ˚C (105 DAT). Maximum relative humidity (7.00AM) was recorded as 89.60 % on 90 DAT whereas it ranged lowest up to 85.60% at 105 DAT. Minimum relative humidity (2.00 PM) during the period of observation ranged from 60.69% to 81.73% at 105 DAT and 30 DAT respectively. During 30 DAT, a highest of 10.51 mm rainfall happened, whereas a total of 33.96 mm rainfall occurred during the period of observation.

Population Trend of Spider Families During the Crop Season

From the Figure 1.b it is clear that for all the six spider families, the population growth showed a gradual increase in the 15^{th}, 30^{th} and 45^{th} DAT followed by a slight decrease in the 60^{th} DAT after which it continued to grow up to the 90^{th} DAT when it reached the peak and then showed a sudden decline at 105 DAT. So for all the spider families the peak population was obtained during the 90^{th} DAT (38, 95,45,58,19 and 13 for Lycosidae, Tetragnathidae, Araneidae,

Oxyopidae, Salicidae and Thomisidae respectively) where as lowest population (10, 17, 2, 5, 2 and 1 for Lycosidae, Tetragnathidae, Araneidae, Oxyopidae, Salicidae and Thomisidae respectively) was counted during the first date of observation i.e., 15 DAT. The number of individuals irrespective of their families also increased as the crop growth advanced and the maximum number (268) was collected in the 90th DAT.

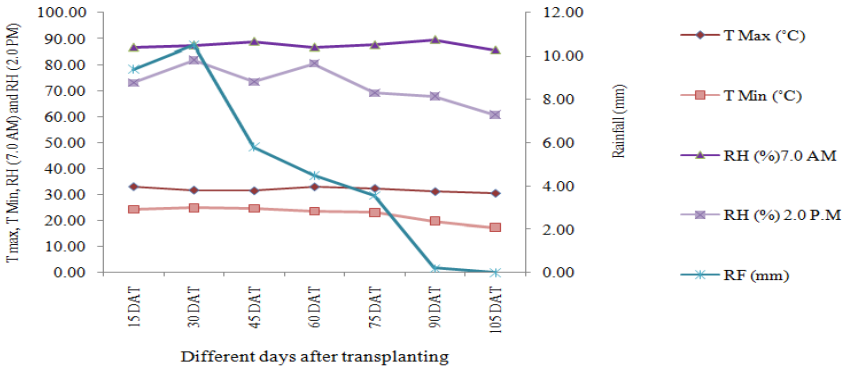

Figure 1.a: Status of Weather Parameters During the Period of Observation

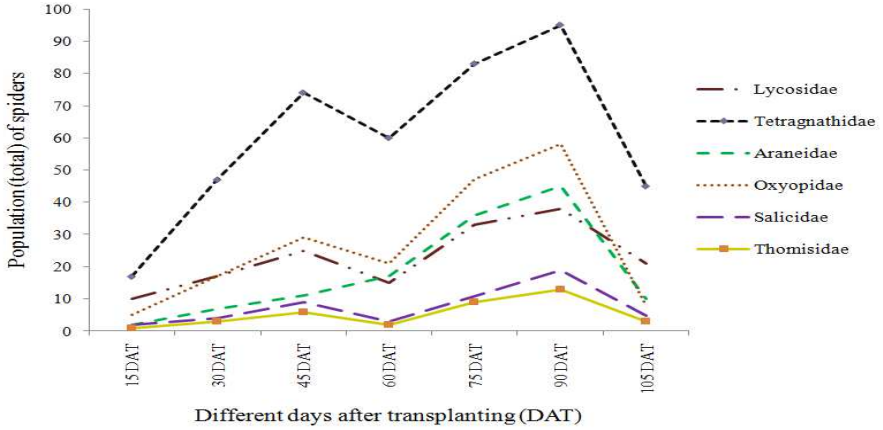

Figure 1.b: Population Dynamics of Different Spider Families During the Period of Observation

Correlation Studies between Weather Parameter and Spider Population

The table 1. Containing the correlation matrix showed that spider populations irrespective of their families were negatively correlated with Maximum temperature (˚C), however not significant in any case. For all the families, minimum temperature (˚C) also had negative impact, although it was not statistically significant. The maximum relative humidity (%) had a significant and positive impact on the population of the spider families, namely Oxyopidae, Salicidae and Thomisidae where as minimum relative humidity had no significance in any of the spider families. Rainfall (mm) was recorded to have a negative impact (non-significant) on the population of spiders irrespective of their families.

Table 1: Correlation Matrix

	Lycosidae	Tetragnathidae	Araneidae	Oxyopidae	Salicidae	Thomisidae
T Max (˚C)	-0.47	-0.32	-0.16	-0.16	-0.43	-0.37
T Min (˚C)	-0.38	-0.17	-0.33	-0.11	-0.35	-0.29

% RH 7 AM	0.68	0.73	0.59	0.79*	0.80*	0.78*
% RH 2 PM	-0.46	-0.16	-0.30	-0.16	-0.40	-0.36
RF (mm)	-0.66	-0.58	-0.64	-0.47	-0.60	-0.56

DISCUSSIONS

The populations of spider species under the genuses *Lycosa*, *Pardosa*, *Gnaphosa*, *Cyclosa*, *Oxyopes*, *Thomisus P. birmanica* and *T. Pugilist* was recorded by Abdul (1998) which peaked during July and August at Faisalabad, Pakistan, which is in contradiction with the present finding where the peak population was recorded during the last week of October (25^{th}).

Hendawy (2004) observed the Egyptian rice fields and the population fluctuations of the common four genera (*Tetragnatha, Araneus, Argiope* and *Singa*) were monitored where they found that *Tetragnatha* spp. often occurred during August and September. The present study also recorded the trend of the increasing population of the spider family Tetragnathidae from last week of September.

The population growth studied by Sudhikumar *et al.,* (2005) showed a gradual increase in the 15^{th}, 30^{th} and 45^{th} DAT followed by a decrease in the 60^{th} DAT after which it continued to grow up to the 90^{th} DAT and reached the peak. The present study done at Sabour also recorded the very similar trend in the population growth of six spider families found in Kharif Paddy.

Singh *et al.*, (2000) found that with crop age and insect pest populations there was a positive correlation, whereas with most of the abiotic parameters there was a negative correlation. The present study also recorded the increasing population growth, according to the crop age, except at 60 DAT and most of the correlation values with the weather parameters (except maximum relative humidity) were negative and statistically nonsignificant, which supported the findings of the work done by Khan and Misra (2003) except for RH at 7AM.

Vijaykumar and Patil (2004) found the correlation of spider populations as negative and non-significant with maximum and minimum temperatures, but positively and non-significantly correlated with average rainfall and morning and evening relative humidities. Among the spiders, lycosids and tetragnathids were dominant in all locations with maximum population densities occurring from the second fortnight of October to the second fortnight of November. In the present study to the maximum and minimum temperature had non-significant and negative impact and the morning relative humidity had positive correlation (non-significant) with spider population? Here in the present study the Lycosid and Tetragnathid spiders were the dominant and their populations were recorded to get the peak during the last week of October which is supported by the findings of the work done by Vijaykumar and Patil (2004). An increase in the spider population, according to the plant growth tends to depend on prey availability and, if the density of prey becomes higher, spiders are expected to increase proportionally to some extent. The peak of population density of spiders coincides with an increase of insect pests (Kiritani *et al*. 1972). In the present study the highest population of spider irrespective of the families was found during 90 DAT at an increasing order from the start of the sampling except at 60DAT. Although pest population data not taken in the present study, but the increasing trend of the spider population might be due to the increasing level of prey availability and the favorable microclimatic condition in the studied rice ecosystem at Sabour.

CONCLUSIONS

For all the six spider families, the population growth showed a gradual increase in the 15^{th}, 30^{th} and 45^{th} DAT

followed by a slight decrease in the 60th DAT after which it continued to grow up to the 90th DAT when it reached the peak and then showed a sudden decline at 105 DAT. The maximum relative humidity (%) had a significant and positive impact on the population of the spider families namely Oxyopidae, Salicidae and Thomisidae. The other meteorological parameters were not found to have a significant effect on the spider families.

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